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(54) Electrode wire feeding device

(57) A wire feeding and straightening device comprising a rotatable hollow housing 1 defining a path for the wire, the housing containing two or more freely rotatable feed rollers 2, each roller being carried by a spindle 4, the spindles being supported in the housing by guides 5, the rollers extending at an angle to the wire such that, when the housing is rotated and the rollers are in contact with the wire, the wire is fed through the device. The housing is accommodated for displacement in a sleeve-like adjusting ring 7, the hollow within the adjusting ring having profiles (e.g. spiral or, as shown conical) of variable diameter accommodating the guides such that, when the housing is displaced relative to the adjusting ring, the guides are influenced by the varying diameter of the profiles. As shown, the housing is so connected to the adjusting ring (by a screw thread means 6) that relative displacement of the housing and ring is achieved by virtue of the torque transmitted from the adjusting ring to the housing, whereby the varying diameters of the profiles cause, via the guides and spindles, a suitable pressure to be exerted by the feed rollers on the wire. In Figure 2 (not shown), the diameter of a wire nozzle bore is automatically adjusted along with roller adjustment.

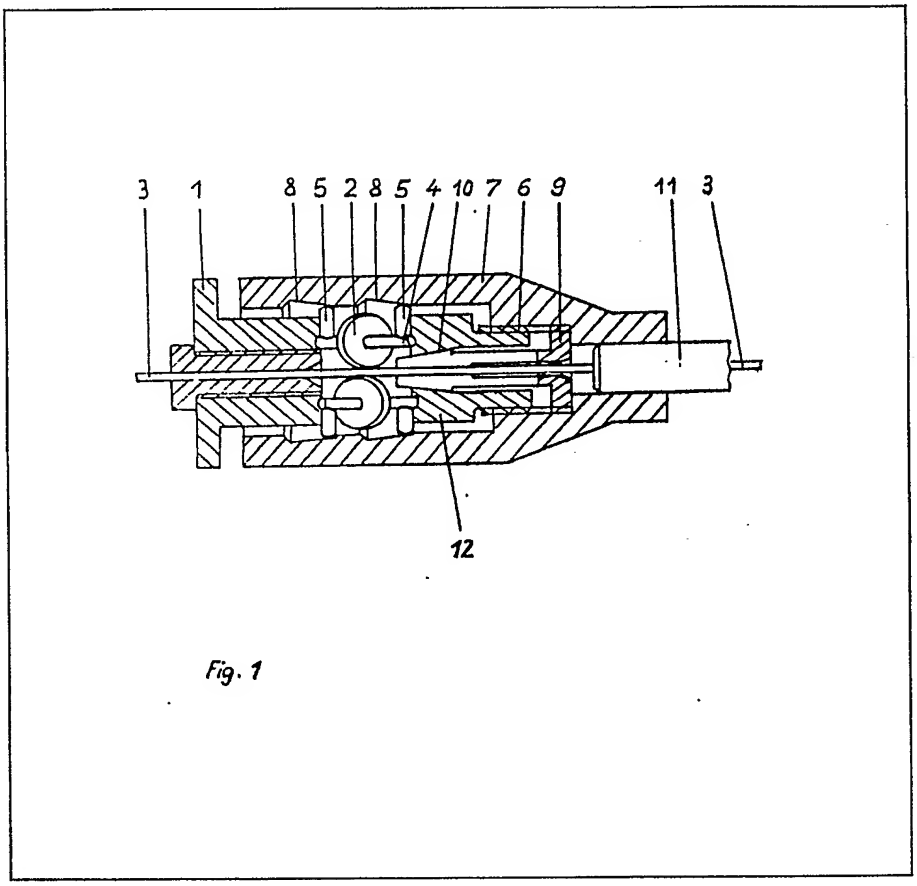

Fig. 1

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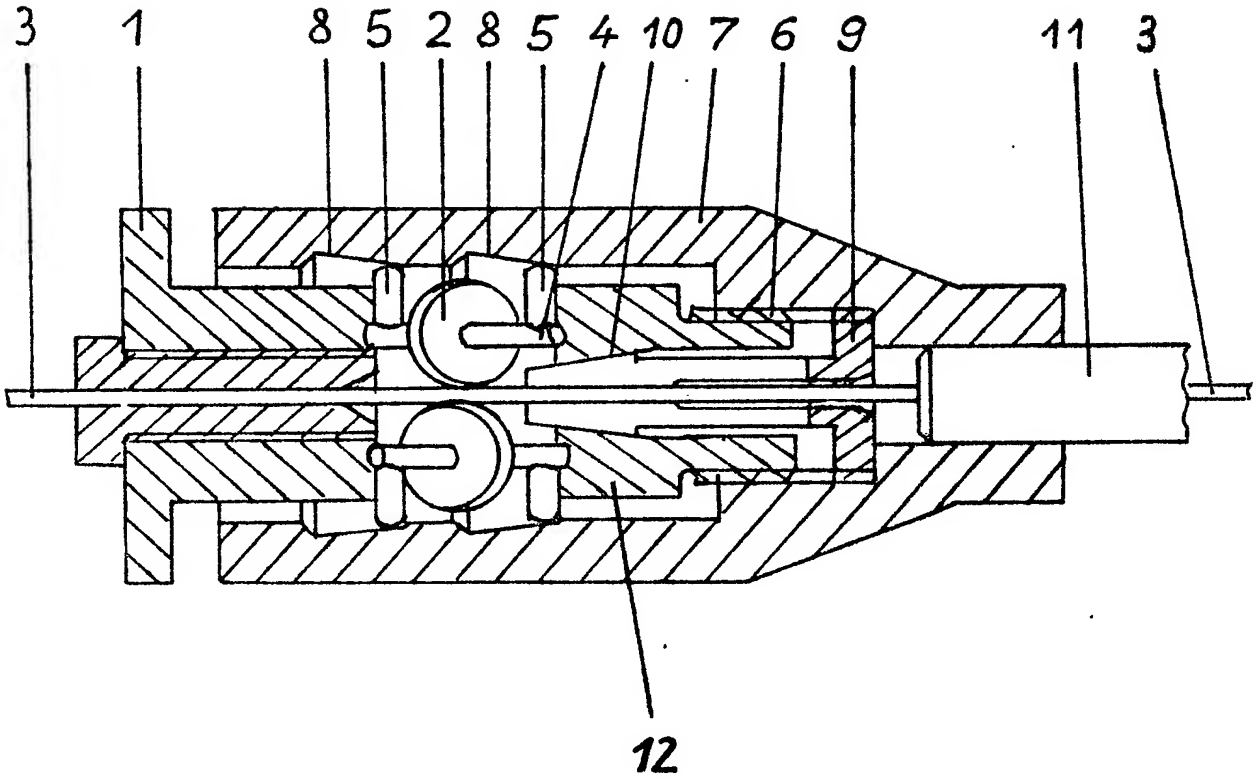

Fig. 1

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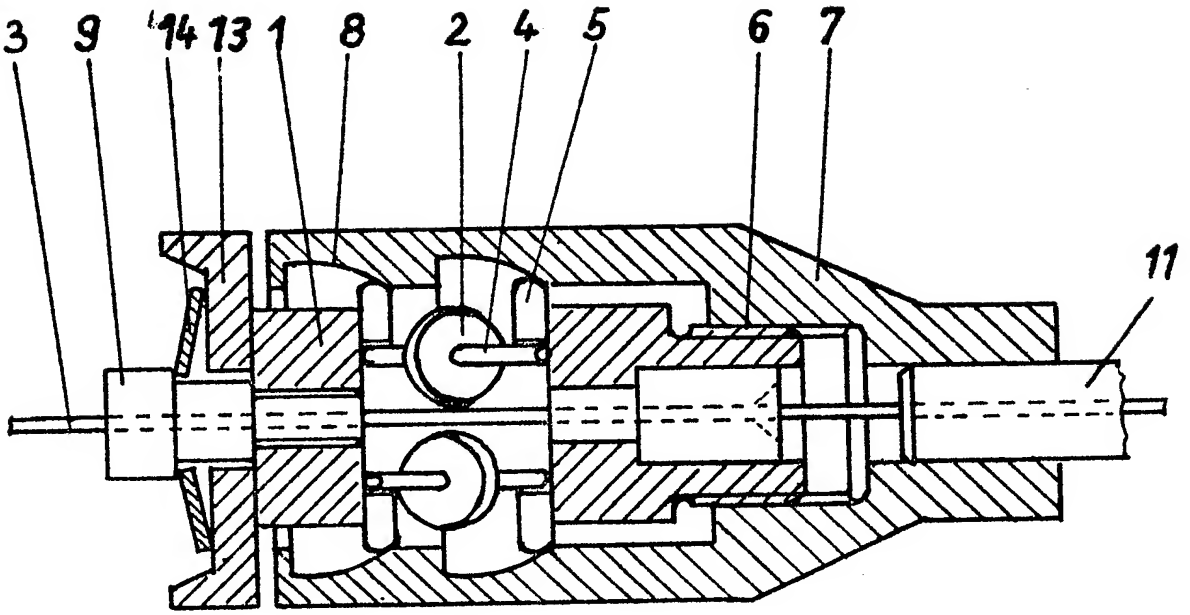

Fig. 2

SPECIFICATION

Wire feeding and straightening device

Background to the invention

This invention relates to a wire feeding and straightening device having an adjusting device and two or more feed rollers which describe a helix as they rotate about the wire, and whose spindles are supported in the housing by guide elements which are preferably movable in a radial direction, and wherein the guide elements are displaced by an adjusting ring having conical bores.

For feeding the electrode wires in electric arc welding, devices are known, which are equipped with rotating feed rollers, whose axes are inclined to the wire axis at a certain angle. The feed rollers are supported in a common housing, which is secured to the drive shaft and through the centre of which the electrode wire is fed. The oblique disposition of the feed rollers has the effect that, as the housing rotates, the feed rollers describe a helix as they roll over the wire, whereby relative movement between the feed head and the electrode wire is produced.

For the purpose of displacing the feed rollers radially and thereby to adjust the pressure exerted by the feed rollers on the electrode wire, a special adjusting device is required.

For the purpose of a radially movable support for the feed rollers in the housing, it has already been propsed to arrange the feed rollers in suitable recesses in a cylindrical housing.

The spindles which are disposed at a particular angle to the wire axis are supported at both ends by cylindrical guide elements, which are guided in the housing and which are radially adjustable by means of two adjusting rings, which are provided with an internal cone. The adjusting rings are mutually independently adjustable by means of screw threads on the housing. The cylindrical guide elements abut against the internal cones of the adjusting rings and are moved radially by rotating the adjusting rings, whereby it is made possible for the feed rollers to exert a pressure on the wire.

The disadvantage of this adjusting system is, by reason of the independent adjustment of the two adjusting rings, there is a danger of the feed rollers being tilted, which has an adverse effect on the efficiency of the arrangement and which results in damage to the wire surface and also in increased wear of the appliance.

Under the conditions prevailing in a welding shop, the uniform adjustment of both adjusting rings without tilting is difficult to achieve, i.e. the requirements for such a welding appliance are too complicated.

There is also known a so-called planet-wheel feed for welding wire, in which the obliquely positioned rollers are each secured to a lever. These levers are secured at their centres of rotation to a wheel holder, whilst the ends of the levers opposite the rollers are each capable of being moved by means of a conical pressure device, whereby the rollers are pressed against the wire. The torque transmitter is in the form of a screw thread, by means of which also a displacement of the pressure device relative to the levers with the feed rollers is effected.

The disadvantage of this feed system is the complicated construction comprising a large number of compoents. Centralised guide of the wire is possible only on one side of the feed rollers. At higher rotational speeds there is moreover the danger that the out of balance forces of the lever system might have a negative effect on the efficiency of the appliance. The unilateral support of the feed rollers on the levers as well as the arrangement and length of the levers permit only the exertion of a limited pressure to the wire.

The feed rollers are adjusted in the radial direction for applying the pressure to the wire, by relative rotation between the housing and the adjusting ring, the tensile force being transmitted via a screw thread and conical guide faces in the adjusting ring to the guide pins and the feed rollers. During tightening by hand or by means of a spanner, the pressure applied by the feed rollers is measured subjectively. Account must be taken of the fact that for different thicknesses and types of wire different pressures are required. In the case of thin wires, excessive pressure results in damage or severance of the wire, whilst in the case of thick wires excessively small pressure is inadequate for continuous feed. As is well known, filler wires are particularly sensitive to excessive pressure. For these reasons it is not possible to eliminate subjective influences by limiting the tensioning torque to a fixed, set value.

For the purpose of introducing the wire, guide nozzles are provided ahead and beyond the feed rollers, which have bores which are matched to the wire diameter, and which have to be changed according to the wire diameter. The guide nozzle at the wire discharge side is secured to the housing by means of screw threads. The guide nozzle on the wire inlet side is less accessible, and as a rule, has to be pushed out of the guide bore from the front of the feed head.

The facility to screw the nozzle in and out by means of a right-handed thread would facilitate the automatic release of the nozzle, having regard to the direction of rotation of the feed head. Hence the attachment of the guide nozzle to the wire inlet cannot, constructionally and functionally, be satisfactory. When the wire thickness is changed, it is necessary to dismantle the feed head and to change the internal guide nozzle by means of a special tool.

Object of the invention

The object of the invention is significantly to improve the reliability of operation of, and convenience of attendance to, welding wires using rotating wire feed systems, and to eliminate technological disadvantages and/or damage to the appliances, particularly the application of an inappropriate pressure by the rollers, as well as to improve the accuracy with which the wire is guided and significantly to reduce the times required for rendering the feed system suitable for a different wire diameter.

Outline of the invention

The aim of the invention is to provide apparatus for satisfactorily adjusting the pressure applied by the feed rollers, which is substantially independent

of subjective influences and which permits the adjustment of the roller pressure according to the particular wire diameter and/or wire type concerned, as well as such apparatus which is usable for different wire diameters without additional provisions having to be made. In accordance with the invention, an adjusting device is provided whose principal component is an adjusting ring in the form of a cylindrical hollow member, one end of which is directly connected to the drive shaft. The adjusting ring is open on the side remote from the drive shaft and is adapted to receive the, preferably cylindrical, housing, known per se, for the obliquely positioned feed rollers.

The housing is supported for axial displacement and/or rotation inside the adjusting ring, adjustment being possible also from the outside by means of an outwardly projecting collar of the housing. The spindles of the feed rollers, which are supported by guide elements in the housing which are preferably movable in the radial direction, can be adjusted in a radial direction by means of a profile on the inside of the adjusting ring. In the course of a suitable relative movement between the housing and the adjusting ring, this profile causes the simultaneous adjustment of all guide elements through the same distance, which corresponds to the desired degree of adjustment of the feed rollers. Preferably the adjusting ring and the housing are so interconnected by means of a screw thread arranged concentrically with the wire axis that, by virtue of the torque which is to be transmitted from the adjusting ring to the housing, and by the interaction of the bore and guide elements, radial adjustment of the feed rollers in the direction of the wire to be fed is achieved. The torque to be transmitted moreover has the effect that a suitable pressure is exerted by the feed rollers on the wire, corresponding to the force required to feed the wire. This pressure exerted by the feed rollers may additionally be produced by relative displacement, preferably angular displacement, between the adjusting ring and the housing by means of a tool or by hand.

The housing and the adjusting ring may, additionally to the screw thread which acts as a union, also be located concentrically by means of a further bearing.

A preferred form of the adjusting device comprises the provision on the inside of the adjusting ring in the contact region of the guide elements of a profiled region for each said guide element in the form of an internal cone which, when the wire is advanced or in the course of an appropriate relative movement between he housing and the adjusting ring, exerts a force on the guide elements which has a centrally directed resultant, and thus, by means of the feed rollers, exerts the force on the wire which is required for feeding the wire.

By providing an oppositely directed profile, additionally to the profile which is effective during advancement of the wire, the required pressure to be exerted by the feed rollers can be produced during forward displacement as well as rearward movement of the wire.

In accordance with a feature of the invention, the areas on the inside of the adjusting ring which position the guide pins and feed rollers, have a continuously variable gradient with respect to the wire axis, so that different angles of the adjusting areas can be achieved within the range of adjustment of the guide pins.

Preferably there is provided a small gradient for the adjustment areas in the region corresponding to a maximum mutual spacing of the feed rollers, and a relatively large gradient of the adjustment areas in the region corresponding to a minimum mutual spacing of the feed rollers. From this it follows that, for thick wires involving a relatively large roller spacing, corresponding to the small gradient of the adjustment areas a relatively high pressure of the feed rollers can be realised. For the same initial torque at the tensioning disc a low roller pressure can be produced for thin wires involving a small roller spacing, and overstressing of the thin wire can be avoided. The torque limitation of the feed head can be set to a fixed value, the outer wire guide nozzle having merely to be designed for fulfilling the function of guiding the wire and consequently being of simplified design. It is however also possible to utilize both torque setting facilities simultaneously, i.e. the range of the adjustable limiting torque can be increased by utilizing both principles of adjustment.

As an alternative to the preferred embodiment using an adjusting ring with a conical bore, the inside of the adjusting ring may be provided with areas in the form of an outwardly increasing spiral, which produces the depth setting of the feed rollers during angular displacement of the adjusting ring with respect to the housing.

When the wire is drawn back, viz. when the feed rollers rotate about the wire in the reverse direction, it is possible that the torque causes the housing to be rotated too far out of the adjusting ring. To counteract this possibility, it is desirable to provide an abutment or a latch for preventing the unintentional withdrawal by rotation of the housing from the adjusting ring.

The adjusting device embodying the invention may also be so configured that the housing and adjusting ring are mutually displaceable in the axial direction of the wire by means of a non-rotatable guide member. The relative displacement of the housing and the adjusting ring for the purpose of producing the pressure to be exerted by the feed rollers may be achieved by means of suitable adjusting devices, e.g., by means of a screw threaded coupling.

In accordance with a preferred embodiment, the adjusting device may be so configured that exchangeable housings having different angles for co-operation with the feed rollers may be provided in conjunction with a standard adjusting ring, a uniform effective spacing of the guide elements from the profile of the adjusting ring being achieved by means of roller spindles of different lengths and the guide elements and roller spindles being firmly connected in both of the possible directions of movement, by means of stub axles and bores, and the feed rollers being prevented from dropping out whilst the housing is being changed.

The advantages of the invention reside in the simple manipulation of the adjusting device, resulting in rapid operational readiness and a high degree of operational reliability of the welding appliances which are equipped with a rotating feed system. The pressure exerted on the feed rollers adjusts itself automatically according to the force required for feeding, whereby subjective influences are largely eliminated. Tilting of the feed rollers is no longer possible when using the adjusting device according to the invention. Thereby damage to the wire surface, interruptions in the wire feed and a high degree of wear and damage to the wire feed device are avoided. Hence the technological advantages of the rotating wire feed system - feeding and simultaneous straightening of the wire - can be fully utilized. As compared with conventional wire feed systems, the manufacturing costs of rotating wire feed systems is considerably reduced. The use of wires of a wide range of different diameters is made possible.

In accordance with a further embodiment, a tensioning disc is provided at the front of the housing which is rotatable within the adjusting ring, the disc being in positive or frictional engagement with the housing and transmitting a limited torque from the tensioning disc to the housing by means of a compression spring. One side of the compression spring, which effects the frictional engagement, acts against the tensioning disc and its other ends abuts against an abutment on the exchangeable wire guide nozzle. Different degrees of pre-compression of the compression spring are achieved by different distances of the abutment from the tensioning disc.

In this way the pressure exerted by the feed rollers and appropriate to the wire diameter is constructively programmed for each of the exchangeable wire guide nozzles. Whenever the diameter of the wire used in the welding equipment is changed, the nozzle at the wire discharge end also has to be changed, the compression spring necessarily setting a new pre-compression, which limits the pressure applied by the rollers to the required value.

The starting torque can be transmitted between the tensioning disc and the housing either by frictional engagement between two plane faces, or the faces are profiled whereby a partial positive engagement up to a particular maximum transmissible force is achieved. Likewise it is possible, by providing balls in one of the discs and corresponding grooves in the other disc, to stress the tensioning disc up to the point where the balls jump into the next position. Instead of the balls, other elements which are suitable for increasing or limiting the transmissible torque may be provided between the tensioning disc and the housing.

The position or angular displacement of the housing with respect to the adjusting ring may also serve as a measure for the pressure exerted by the feed rollers. In particular, the housing or adjusting ring may comprise a scale indicating the optimum positions for the different wire diameters or an indication of the pressures exertable by the wire feed rollers or of the feed forces of the wire.

No special resilient elements for transmitting the pressure are provided in the pressure system of the wire feed rollers, because these cause a reduction in the pressure exerted by the wire feed rollers at relatively high rates of rotation on account of the effect of the centrifugal force. For the purpose of compensating for the small permissible tolerances in the thickness of the wire, the spindles of the wire feed rollers and/or the adjusting ring may be made of a resilient material preferably of spring steel. By means of suitable dimensioning of the spindles and of the adjusting ring, a small degree of bending of the order of magnitude of the tolerances of the wire diameter should be made possible, these tolerances being accommodated without any significant increase in the pressure exerted by the wire feed rollers.

The advantages of this embodiment reside in the fact that the pressure exerted by the feed rollers, which take into account the diameters and types of wire, is set reliably and without any subjective influences. In this way interruptions of the welding operation owing to unsatisfactory adjustment of the feed system are avoided.

Significantly less effort on the part of the welder in relation to the welding equipment is required.

A simplification of the wire guide system is achieved by providing the housing with an internal cone, which corresponds to the cone of a slotted, conically constructed wire guide nozzle. The wire guide nozzle consists of a plurality of, preferably three or four, guide elements, which are arranged in a conical bore of the housing or of the adjusting ring for displacement in the axial direction of the wire, the wire guide nozzle being internally connected to the adjusting ring either permanently or detachably. The conical face of the wire guide nozzle has the same angle of inclination as the bore of the adjusting ring. The guide elements are so joined to the adjusting ring or the housing, that only radial movement of the guide elements is possible, whilst they are longitudinally displaceable and radially adjustable by means of the conical bore, in the other component concerned, i.e. the housing or the adjusting ring.

The slotted nozzle section is outwardly biassed, so that the wire guide nozzle is automatically opened up when the feed rollers are moved apart; the non-slotted section of the wire guide nozzle serves to secure the latter to the bottom portion of the adjusting ring or, in the case of the converse arrangement of the wire guide nozzle, for securing it to the housing.

Preferably the wire guide nozzle is secured to the bottom portion of the adjusting ring either permanently or detachably, because thereby the electrode wire is guided right up to the immediate vicinity of the feed rollers. The spacing of the wire guide nozzle or guide elements from the feed rollers is least in the case of thin electrode wires and relatively greatest in the case of thick electrode wires. The larger spacing of the guide means in the case of thick electrode wires, however, is no disadvantage because of the greater stiffness of the electrode wire.

Thanks to the invention, the dismantling of the feed head and the changing of the inner guide nozzle

is eliminated when changing from one electrode wire diameter to the other. There is thus achieved for each wire diameter the optimum nozzle bore up to the feed rollers. Hence the electrode wire is transported to all rotational speeds without any oscillatory effects and damage to the wire surface in the form of vibration marks is avoided. The introduction of the start of the wire into the feed head whilst the nozzle bore is opened to its maximum value presents no problems.

Two embodiments of a device according to the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a section through a first embodiment having a self-adjusting wire guide nozzle; and

Figure 2 shows a section through a second embodiment with torque adjustment of wire feed rollers.

Referring to the drawings, in which like integers are identified by like reference numerals, the simplest manner of embodying the invention entails positioning freely rotatable wire feed rollers 2 in a cylindrical housing 1 at an angle of e.g. 40° to the axis of the electrode wire 3. Spindles 4 of the wire feed rollers 2 are operatively associated with cylindrical guide elements 5, which are radially displaceable. The housing 1 is secured to the bottom portion of an adjusting ring 7 via a screw thread 6. Two profiled grooves 8 of gradually variable diameter, which may be e.g. frusto-conical (not shown), double frusto-conical (Figure 1), in the shape of a helical cone spring (not shown), or part-spherical (Figure 2), are provided in the adjusting ring 7. Turning of the adjusting ring 7 relative to the housing 1 causes the screw thread 6 to cause relative axial displacement of the parts 1, 7, whereby the grooves 8 in the adjusting ring 7 effect displacement of the guide elements 5 and hence also the wire feed rollers 2. One end of the adjusting ring 7 is secured directly to the shaft 11 of a driving motor, the wire 3 being fed through the shaft 11. The pitch of the screw thread 6 between the housing 1 and the adjusting ring 7, and the gradient of the conical groove 8 are so chosen, that the correct pressure is applied by the feed rollers 2 to the wire 3, by the torque to be transmitted.

In accordance with a further feature of the invention, the conical groove 8 may be so designed that the angle of inclination of the groove to the wire axis is small relative to the said angle in the region of smaller said diameter, the angle of inclination varying continuously from O° to e.g. 30°.

In order to ensure that the pressure exerted by the wire feed rollers 2 on the electrode wire 3 is at all times at an optimum, adjusting device is, in accordance with a further feature of the invention, provided (as shown in Figure 2) at the front of the housing 1; this adjusting device comprises a tensioning disc 13 and a Belleville or disc spring 14. The disc spring 14 abuts against an exchangeable wire guide nozzle 9.

For each particular wire diameter a spring wire guide nozzle 9 having an appropriate bore and an abutment for the disc spring 14 which is designed to provide the required spring pressure, is available.

Figure 1 also shows the arrangement of a self-adjusting form of the nozzle 9. The nozzle 9 has a conical part 10 and is screwed into the screw thread 6 at the end of the adjusting ring 7; it is slotted and of conical configuration in its slotted portion, the angle of inclination of its internal cone 12 corresponding to the angle of inclination of the conical bore 8 in the adjusting ring 7. The slotted part of the wire guide nozzle 9 is biassed radially outwardly and enables a trouble-free introduction of the entry end of the wire, when the wire feed rollers 2 are appropriately positioned. The effective diameter of the slotted wire guide nozzle 9 automatically adjusts itself to its optimum value upon the application of the wire feed rollers 2 to the wire 3.

CLAIMS

1. A wire feeding and straightening device comprising a rotatable hollow housing defining a path for the wire, the housing containing two or more freely rotatable feed rollers, each roller being carried by a spindle, the spindles being supported in the housing by guide elements, the rollers extending at an angle to the wire such that, when the housing is rotated and the rollers are in contact with the wire, the wire is fed through the device while each roller, as it rotates, describes a helix about the wire, wherein the housing is accommodated for axial displacement in an adjusting ring which is adapted to be firmly secured to a hollow drive shaft and which is in the form of a hollow body, the hollow within the adjusting ring being provided with profiles receiving the guide elements such that, when the housing is displaced relative to the adjusting ring, the diameter of the profiles in the cross-sectional plane in which the guide elements are situated continuously varies, the housing being so connected to the adjusting ring that relative displacement of the housing and ring is achieved by virtue of the torque transmitted from the adjusting ring to the housing until a suitable pressure is exerted by the feed rollers on the wire.

2. A device according to Claim 1 wherein each of the profiles is in the shape of a frusto-conical recess, of a double frusto-conical recess, of a helical cone spring, or of a part-spherical recess.

3. A device according to Claim 1 wherein the profiles, which are adapted to set the guide elements and feed rollers, have a continuously varying inclination relative to the wire axis, a small angle of inclination being provided in the adjustment range of the guide elements which corresponds to a maximum mutual spacing of the feed rollers, and a larger angle of inclination of the profiles is provided in the adjusting range which corresponds to a minimum spacing between the feed rollers.

4. A device according to Claim 1 or 2 wherein exchangeable housings having feed rollers at different angular positions are provided for a standard adjusting ring, the same effective spacing of the guide elements with respect to the profiles of the adjusting ring being obtained by providing roller spindles of different lengths and the guide elements being firmly connected to the roller spindles by

means of a stub axle and bore in both possible directions of movement of the guide elements and secured against the feed rollers dropping out whilst the housing is being changed.

5. A device according to any one of Claims 1 to 3 including an exchangeable wire guide nozzle, a tensioning disc and a compression spring, the tensioning disc being situated at the front of the housing and being in engagement with the housing, the spring acting on the tensioning disc and being held against the wire guide nozzle which is secured inside the housing by means of an abutment, the wire guide nozzle being designed for a variety of diameters and types of wire and having different distances of the abutment from the tensioning disc appropriate to the required engagement.

6. A device according to Claim 5 wherein torque-transmitting faces of the tensioning disc and of the housing are profiled.

7. A device according to any one of Claims 1 to 6 including markings for controlling the position of the housing relative to the adjusting ring, the markings being provided on the housing or on the adjusting ring and indicating the wire diameter and/or grading of pressures exerted by the feed rollers on the wire.

8. A device according to any one of Claims 1 to 7 wherein the spindles of the wire feed rollers and/or the adjusting ring are made of a resilient material and are so dimensioned that the permissible tolerance of the wire diameter that the permissible tolerance of the wire diameter is accommodated without any significant increase in the pressure exerted by the feed rollers.

9. A device according to Claim 5 or 6 and any claim appended thereto wherein elements for increasing the transmissible torque are provided between torque transmitting faces of the tensioning disc and the housing.

10. A device according to Claim 5 or any claim appended thereto wherein the housing is provided with a conical axial hole which corresponds to a conical part of a slotted, conically constructed wire guide nozzle, which is secured to and coaxial with the adjusting ring, the conical part of the wire guide nozzle having the same angle of inclination as the profiles of the adjusting ring, the slotted nozzle section being outwardly biassed.

11. A device according to any one of Claims 1 to 10 wherein the housing is connected to the adjusting ring by a screw thread.

12. A wire feeding and straightening device constructed, arranged and adapted to operate substantially as herein described with reference to, and as shown in, the accompanying drawings.

13. An apparatus including a device according to any one of Claims 1 to 12.

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ABSTRACT:

CHG DATE=19990617 STATUS=O> A wire feeding and straightening device comprising a rotatable hollow housing 1 defining a path for the wire, the housing containing two or more freely rotatable feed rollers 2, each roller being carried by a spindle 4, the spindles being supported in the housing by guides 5, the rollers extending at an angle to the wire such that, when the housing is rotated and the rollers are in contact with the wire, the wire is fed

through the device. The housing is accommodated for displacement in a sleeve-like adjusting ring 7, the hollow within the adjusting ring having profiles (e.g. spiral or, as shown conical) of variable diameter accommodating the guides such that, when the housing is displaced relative to the adjusting ring, the guides are influenced by the varying diameter of the profiles. As shown, the housing is so connected to the adjusting ring (by a screw thread means 6) that relative displacement of the housing and ring is achieved by virtue of the torque transmitted from the adjusting ring to the housing, whereby the varying diameters of the profiles cause, via the guides and spindles, a suitable pressure to be exerted by the feed rollers on the wire. In Figure 2 (not shown), the diameter of a wire nozzle bore is automatically adjusted along with roller adjustment. □